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NATIONAL DAM SAFETY PROGRAM, A. O. SHEARRER LAKE DAM (MO 30563)--ETC(U)

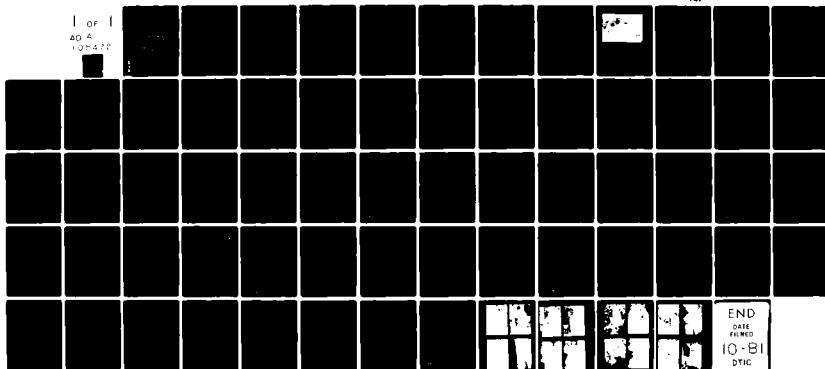
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MISSISSIPPI-ST. FRANCIS RIVER BASIN

A.O. SHEARRER LAKE DAM
WAYNE COUNTY, MISSOURI
MO 30563

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



United States Army
Corps of Engineers

... Serving the Army
... Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI



NOVEMBER, 1980

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14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (10) Steven L. Brady Gene /Wertepny Dan /Kerns Tom /Beckley		12. REPORT DATE (11) November 1980
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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Date: _____

MISSISSIPPI-ST. FRANCIS RIVER BASIN

A. O. SHEARRER LAKE DAM
WAYNE COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30563

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

NOVEMBER, 1980

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam: A. O. Shearrer Lake Dam
State Located: Missouri
County Located: Wayne
Stream: Tributary of Little Lake Creek
Date of Inspection: October 7, 1980

A. O. Shearrer Lake Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately three miles downstream of the dam. Located within this zone are three dwellings, two trailers, three buildings, a church, and a cemetery.

The dam is in the small size classification, since it is greater than 25 ft high but less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1,000 ac-ft.


Our inspection and evaluation indicates that the combined spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 11 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering

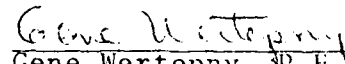
the low height of dam (28 ft) and the small storage capacity (83.0 Acre-ft) 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year flood (1 percent probability flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being exceeded in any given year.

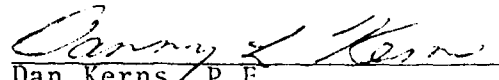
The embankment was in good condition. Deficiencies visually observed by the inspection team were: (1) Scattered brush and trees on embankment faces; (2) Brush and trees in approach channel to emergency spillway channel; (3) No wave protection for upstream face; (4) Non-erodible emergency spillway section not provided; (5) Emergency spillway outlet channel not diverted away from embankment; (6) Brush and trees in downstream channel; and (7) Erosion at the principal spillway outlet.

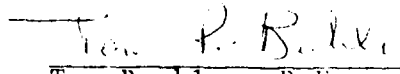
Another deficiency was the lack of seepage and stability analysis records.

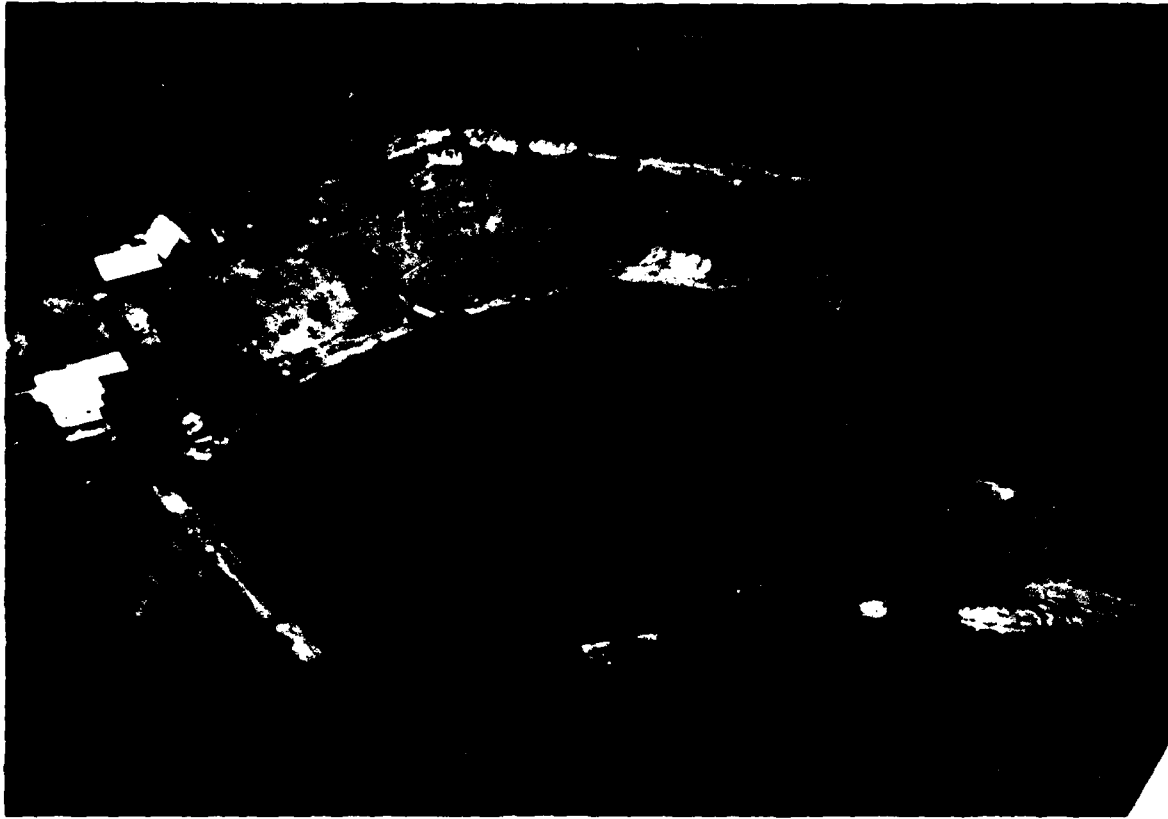
It is recommended that the owners take the necessary action without undue delay to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.


Steven L. Brady, P.E.
Anderson Engineering, Inc.


Gene Wertepny, P.E.
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AERIAL VIEW OF LAKE AND DAM

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
A. O. SHEARRER LAKE DAM
MISSOURI INVENTORY NO. 50563

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-567, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of A. O. Shearrer Lake Dam in Wayne County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

A. O. Shearrer Lake Dam is an earth fill structure approximately 28 ft high and 330 ft long at the crest. The appurtenant work consists of a 1 inch irrigation pipe with two downstream valves, an uncontrolled 12 inch corrugated metal principal spillway pipe, and an earth cut emergency spillway section.

Sheet 3 of Appendix A shows a plan, profile, and typical section of the embankment. Sheets 4 and 5 of Appendix A show a profile and section of the emergency spillway.

B. Location:

The dam is located in the central part of Wayne County, Missouri on a tributary of Little Lake Creek. The dam and lake are within the Patterson, Missouri 7.5 minute quadrangle sheet (Section 32, T29N, R05E - latitude 37°08.8'; longitude 90°31.1'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 28 ft and a maximum storage capacity of approximately 83 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification. The estimated damage zone extends approximately three miles downstream of the dam. Located within this zone are 3 dwellings, 2 trailers, 3 buildings, a church, and a cemetery. The affected features within the damage zone were field verified by the inspection team.

E. Ownership:

The dam is owned by Mr. A. O. Shearrer. The owner's address is Route 1 Box 42, Patterson, Missouri 63956.

F. Purpose of Dam:

The dam was constructed primarily for domestic water supply and recreation.

G. Design and Construction History:

The dam was designed by the Greenville, Missouri branch of the U. S. Department of Agriculture, Soil Conservation Service in 1964. Mr. Shearrer stated that the dam was constructed 12 years ago. He could not recall the name of the contractor that constructed the dam. Mr. Shearrer stated that he instructed the contractor to increase the width of the embankment to 18 ft and to provide a 3H on 1V slope on the downstream face of the dam.

According to the owner, the material for the core trench was obtained from the hillside immediately east of the dam and select material from the lake bed. The core trench was reported to have been 11 ft wide and 5 ft deep. The material for the impervious core and the embankment was obtained from the lake bed area.

During the construction phase, Mr. Shearrer changed the location of the emergency spillway to the east abutment from the design location at the west abutment. The principal spillway pipe, 12 inch diameter CMP, was installed at the design location. An additional 1 inch diameter copper pipe was installed through the embankment near the west abutment. This pipe was to provide irrigation to a garden immediately downstream of the embankment. Two valves were installed in a concrete pit at the toe of the embankment.

Mr. Shearrer stated that the contractor pulled off the job prior to completion of the final grading of the embankment.

The pump house for the domestic water supply is located near the west abutment. The inlet pipe extends from the pump house, along the lake bottom to the inlet about 100 ft from the shoreline.

II. Normal Operating Procedures:

Normal flows are passed by the uncontrolled principal spillway pipe, located near the east abutment and the uncontrolled earth cut emergency spillway at the east abutment. Mr. Shearrer indicated that the dam has not been overtopped. The maximum high water, to his knowledge, was to within 4 inches of the emergency spillway (Elevation 509.9).

About 4 years ago Mr. Shearrer stated that the lake level was lowered about 2 ft below normal pool by siphoning through a 4 inch pipe, laid over the embankment crest, to a downstream pond. The purpose was to provide water to a neighbor for irrigation.

The 1 inch copper pipe is now used periodically to water livestock.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile, and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 112 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through uncontrolled spillways.
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 511.2): 30 cfs
- (3) Estimated Capacity of Principal Spillway: 5 cfs
- (4) Estimated Capacity of Emergency Spillway: 25 cfs
- (5) Estimated Experience Maximum Flood at Dam Site: 5 cfs (Elevation 509.9)
- (6) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable
- (7) Diversion Tunnel Outlet at Pool Elevation: Not Applicable
- (8) Gated Spillway Capacity at Pool Elevation: Not Applicable
- (9) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level elevation of 510.0 for the top of slab at the southeast corner of the pump house (estimated from quadrangle map).

- (1) Top of Dam: 511.2 ft, MSL
- (2) Principal Spillway Crest: 508.0 ft, MSL
- (3) Emergency Spillway Crest: 510.2 ft, MSL
- (4) Principal Spillway Pipe Invert at Outlet: 487.4 ft, MSL
- (5) Streambed at Centerline of Dam: 485.0 ft, MSL
- (6) Pool on Date of Inspection: 504.8 ft, MSL
- (7) Apparent High Water Mark: 509.9 ft, MSL
- (8) Maximum Tailwater: Not Applicable
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

- (1) At Top of Dam: 900 ft
- (2) At Emergency Spillway Crest: 850 ft
- (3) At Principal Spillway Crest: 750 ft

E. Storage Capacities:

- (1) At Top of Dam: 83 Acre-ft
- (2) At Emergency Spillway Crest: 75 Acre-ft
- (3) At Principal Spillway Crest: 60 Acre-ft

F. Reservoir Surface Areas:

- (1) At Top of Dam: 8.0 Acres
- (2) At Emergency Spillway Crest: 7.5 Acres
- (3) At Principal Spillway Crest: 6.3 Acres

G. Dam:

- (1) Type: Rolled Earth
- (2) Length at Crest: 330 ft
- (3) Height: 28.0 ft
- (4) Top Width: 18 ft
- (5) Side Slopes: Upstream varies from 1V on 2.3H to 1V on 2.9H;
Downstream varies from 1V on 2.2H to 1V on 4.4H
- (6) Zoning: Apparently Homogeneous
- (7) Impervious Core: 11 ft wide clay core
- (8) Cutoff: Key trench to clay
- (9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

- (1) Type: Not Applicable

- (2) Length: Not Applicable
- (3) Closure: Not Applicable
- (4) Access: Not Applicable
- (5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

- (1) Location: Station 3 + 00
- (2) Type: 12 inch diameter corrugated metal pipe with hooded inlet

I.2 Emergency Spillway:

- (1) Location: East Abutment
- (2) Type: Earth Cut Swale
- (3) Upstream Channel: Earth Cut Channel, brush and tree lined
- (4) Downstream Channel: Grass covered to wooded Earth Channel with moderate side slopes

J. Regulating Outlets:

The regulating outlet associated with this dam is the 1 inch diameter copper pipe, with downstream valves, installed for irrigation purposes.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

The design of this dam was done by the Soil Conservation Service. The calculations are on file with the Columbia, Missouri Soil Conservation Service office. A copy of the design plans are included as Sheets 7 and 8 of Appendix A. The location of the emergency spillway as designed to be at the west abutment was changed by the owner to be at the east abutment. No documentation of construction inspection records is known to exist. To our knowledge, there are no documented maintenance data.

A. Surveys:

A pre-construction survey, using an assumed datum, was conducted by the Soil Conservation Service. This survey is on file in the Columbia, Missouri office.

The southeast corner of the top of the pump house slab was used as reference for all field measurements. An elevation of 510.0 mean sea level was estimated for this point using U.S.G.S. quad sheets.

B. Geology and Subsurface Materials:

The site is located at the southwestern limits of the St. Francois Mountains geologic region of Missouri. The St. Francois Mountains are described as an island of crystalline rocks entirely surrounded by the Salem Plateau. The area is characterized topographically by steep mountains of Precambrian age. These mountains are highly resistant to erosion as compared with the once-overlying Paleozoic formations. These igneous mountains are encircled by dolomite, sandstone and chert of the Cambrian system.

Information from the Missouri Department of Natural Resources indicates that the bedrock in the area is the Gasconade Dolomite, which is predominately a light brownish-gray, cherty dolomite. The formation contains a persistent sandstone unit in its lowermost part that is designated the Gunter member. The lower part of the dolomite which overlies the Gunter member is coarsely crystalline and characterized by large amounts of chert. The upper part of the dolomite is predominately finely crystalline and contains smaller amounts of chert. Caves and springs are common in the Gasconade formation.

The publication "Caves of Missouri" lists three caves known to exist in Wayne County, the closest being about four miles northeast of the site. Of two caves listed in adjacent Reynolds County, the closest is about twenty miles northwest of the site. No caves are listed in adjacent Iron and Madison Counties.

Information from the United States Department of Agriculture Soil Conservation Service indicates that the soils in the immediate area of the dam and lake consist primarily of Clarksville Stony Silt Loam. The Clarksville series subsoil is a reddish-brown to red silty clay to heavy, stiff, tenacious, compact clay. These residual soils are derived from cherty and dolomitic limestones. Chert fragments are very common in the Clarksville soils. The loessial thickness map indicates that upland areas may have about 2.5 ft of loess cover.

C. Foundation and Embankment Design:

No design computations are available. Seepage and stability analyses apparently were not performed as required in the guidelines. There is apparently no particular zoning of the embankment, and no internal drainage features are known to exist.

D. Hydrology and Hydraulics:

The hydrology and hydraulics design calculations obtained for this dam are included on Sheet 6 of Appendix A. This is the standard design sheet prepared by the Soil Conservation Service. Based upon the design plans obtained, field measurements of spillway dimensions, embankment elevations, and a check of the drainage area on U.S.G.S. quad sheets, hydrologic analyses using U. S. Army Corps of Engineers guidelines were performed and appear in Appendix C, Sheets 1 through 10.

E. Structure:

The details of the structure and principal spillway pipe are included as Sheet 7 of Appendix A. The detail sheet is the standard Soil Conservation Service design sheet.

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION:

Normal flows are passed by the uncontrolled principal spillway pipe and the uncontrolled earth cut emergency spillway section.

2.4 EVALUATION:

A. Availability:

The engineering data available are as listed in Section 2.1.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record.

C. Validity:

The design information prepared by the Soil Conservation Service is to be considered valid engineering data. No valid engineering data on the design or construction of the embankment was obtained.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on October 7, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc., of Springfield, Missouri and Hanson Engineers, Inc., of Springfield, Illinois. The team members were:

Steven L. Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom R. Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulic Engineer)
Dan Kerns - Hanson Engineers, Inc. (Geotechnical Engineer)

The owner of the dam accompanied the team members during the inspection.

Photographs of the dam, appurtenant structures, reservoir, and downstream features are presented in Appendix D.

B. Dam:

The embankment appears to be in good condition. The horizontal alignment of the dam is good. The profile of the embankment crest at the centerline of dam indicates an upward slope from the west abutment to the emergency spillway channel at the east abutment. The low point of the crest is at elevation 511.2 (Station 1 + 00) and the high point of the crest is at elevation 512.9 (Station 3 + 35). The embankment appeared to have been constructed with the apparent low point at Station 1 + 00. The width of the embankment at the crest is 18 ft. The dam, as designed, was to be 10 ft wide at the embankment crest.

The upstream slope of the embankment was in good condition with no serious erosion noted. No wave protection for the upstream slope was observed. The slope of the upstream face varied from 1V on 2.2H to 1V on 2.9H. Some light brush and small trees were noted on the slope.

The crest of the dam had a good grass cover. No cracks or apparent settlement were observed in the crest of the embankment.

The downstream slope of the dam was generally grass covered, with some light brush and small trees noted. The slope of the downstream face varied from 1V on 2.2H at the crest to 1V on 4.4H at the toe. The junctions of the embankment and abutments were good. No serious erosion or seepage was observed along the slope. No animal burrows were noted on the embankment slopes.

Shallow auger probes in the embankment indicate the embankment to consist of a light reddish-brown very fine sandy silt with rock fragments (ML).

C. Appurtenant Structures:

C.1 Principal Spillway:

The approach to the 12 inch hooded spillway pipe was clear. The wire mesh trash screen appeared to be in good condition with no accumulated debris. Collapse of the trash screen is probable at time of flood flows. Additionally, debris could be carried over the top of the trash screen. The outlet of the spillway pipe was slightly above the toe of the embankment in a dense growth of brush and trees. Some erosion was evident around the pipe outlet and immediately downstream of the pipe.

C.2 Emergency Spillway:

The emergency spillway is an earth cut swale in the east abutment. The approach channel contains many small trees and brush. No permanent control section is provided in the grass covered spillway section. No apparent erosion of the control section was observed. The owner stated that the emergency spillway has not been used. Spillway releases, after passing through the control section, would flow along the junction of the embankment and abutment.

D. Reservoir:

The watershed is generally wooded and grass covered with moderate slopes. No serious erosion or sloughing was noted. Minor sedimentation of the reservoir area was observed, with no effect upon the reservoir noted.

E. Downstream Channel:

At the principal spillway outlet and for an additional 200 ft, the downstream channel is heavily wooded with moderate side slopes. The channel beyond is well defined with light brush and tree growth and relatively mild side slopes.

3.2 EVALUATION:

Trees and brush on the dam constitute a potential seepage hazard and encourage animal burrowing. Lack of wave protection for the upstream face of the embankment can result in serious erosion problems. The discharge capacity of the principal spillway is reduced due to the brush and tree growth, and can restrict flood flows. Lack of a non-erodible control section and discharge along the embankment-abutment junction can cause progressive erosion due to spillway releases which would result in a decrease of the embankment stability. Tree growth in the approach channel of the emergency spillway will restrict normal flows.

The Bermuda grass, sown recently by the owner, is providing a dense grass cover on the embankment. Continued seeding and maintenance of the grass will greatly assist in the total maintenance program required.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

The pool is normally controlled by rainfall, runoff, evaporation, and the capacity of the uncontrolled spillways. The 1 inch copper pipe is used periodically to provide water for livestock.

4.2 MAINTENANCE OF DAM:

The owner is presently attempting to obtain a bermuda grass cover on the crest and side slopes. Small patches of the grass are now present on the dam. No additional maintenance program is in effect.

4.3 MAINTENANCE OF OPERATING FACILITIES:

The valve at the downstream end of the 1 inch copper pipe is used and maintained on a regular basis by the owner.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

There is no existing warning system for this dam.

4.5 EVALUATION:

The tree and brush growth on the dam and in the spillway channels, lack of wave protection, lack of a non-erodible control section, and spillway discharges along the embankment-abutment junction are deficiencies which should be corrected. Remedial measures should be investigated by an engineer experienced in the design and construction of dams. A program of regular maintenance of the operating facilities should be established and followed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

The available SCS hydrologic and hydraulic design data are contained in the plans for construction (Sheet 6, Appendix A).

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for this lake and watershed. The owner indicated that the maximum water level in the lake was to within 4 inches of the emergency spillway. According to the owner the emergency spillway has never operated.

C. Visual Observations:

The approach to the principal spillway is clear and the trash screen is in good condition. The approach to the emergency spillway and the outlet channel of the principal spillway contain brush and tree growth. Considerable erosion was observed at the outlet of the principal spillway. A non-erodible control section is not provided for the emergency spillway and flows through the spillway are not diverted away from the embankment.

D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U. S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on: (1) a field survey of spillway dimensions and embankment elevations; (2) a review of the plans prepared by SCS; and (3) an estimate of the reservoir storage and the pool and drainage areas from the Patterson, Missouri 7.5 Minute U.S.G.S. quad sheet.

Based on the hydrologic and hydraulic analysis presented in Appendix C, the combined spillways will pass 11 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of

the Chief of Engineers, recommend that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the height of dam (28 ft) and the maximum storage capacity (83 Acre-ft) 50 percent of the PMF has been determined to be the appropriate spillway design flood. The spillways will pass a 1 percent probability flood without overtopping the dam.

Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 2,613 cfs. For 50 percent of the PMF, the peak inflow was 1,307 cfs.

The routing of 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by 1.5 ft at elevation 512.7. The duration of the overtopping will be 8.3 hours, and the maximum outflow will be 1,063 cfs. The maximum discharge capacity of the spillways is 50 cfs. The routing of the PMF indicates that the dam will be overtopped by 2.1 ft at elevation 513.3. The maximum outflow will be 2,255 cfs, and the duration of overtopping will be 13.7 hours. Considering the duration of overtopping, 8.3 hours for the routing of 50 percent of the PMF, probable serious erosion could lead to failure of the structure due to overtopping.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

There have been no reported post-construction changes or modifications to this dam.

E. Seismic Stability:

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is in good condition. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) Scattered brush and trees on embankment faces; (2) Brush and tree growth in approach channel to emergency spillway channel; (3) Lack of wave protection for upstream face; (4) Non-erodible emergency spillway control section not provided; (5) Emergency spillway outlet channel not diverted away from embankment; (6) Brush and tree growth in downstream channel; and (7) Erosion at the principal spillway outlet.

Another deficiency was the lack of seepage and stability analyses records.

The dam will be overtopped by flows in excess of 11 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished without undue delay. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not

provided, the embankment condition will deteriorate and possibly could become serious in the future. The items recommended in paragraph 7.2A should be pursued without undue delay.

D. Necessity for Additional Inspection:

Based on the result of the Phase I inspection, no additional inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Alternatives:

- (1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

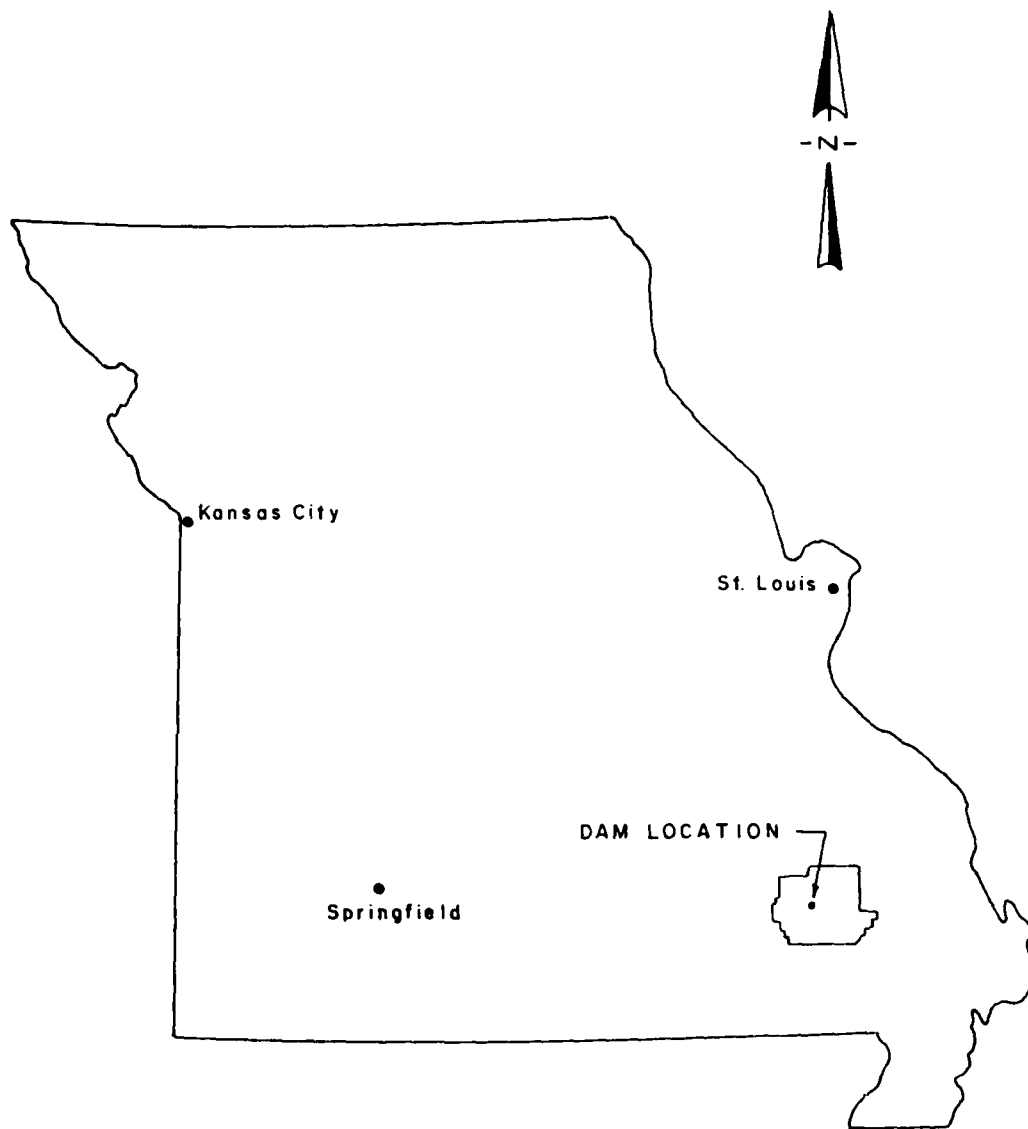
B. O & M Procedures:

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (2) Brush and tree growth should be removed from the embankment and the spillway channel. This should be done under the guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.
- (3) Wave protection should be provided for the upstream face of the dam.

- (4) The outlet of the emergency spillway channel should be diverted away from the embankment.
- (5) The eroded area at the outlet of the principal spillway pipe should be repaired and maintained.
- (6) A non-erodible emergency spillway control section should be provided.
- (7) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Dam Location and Plans



A/E ANDERSON
ENGINEERING, INC.

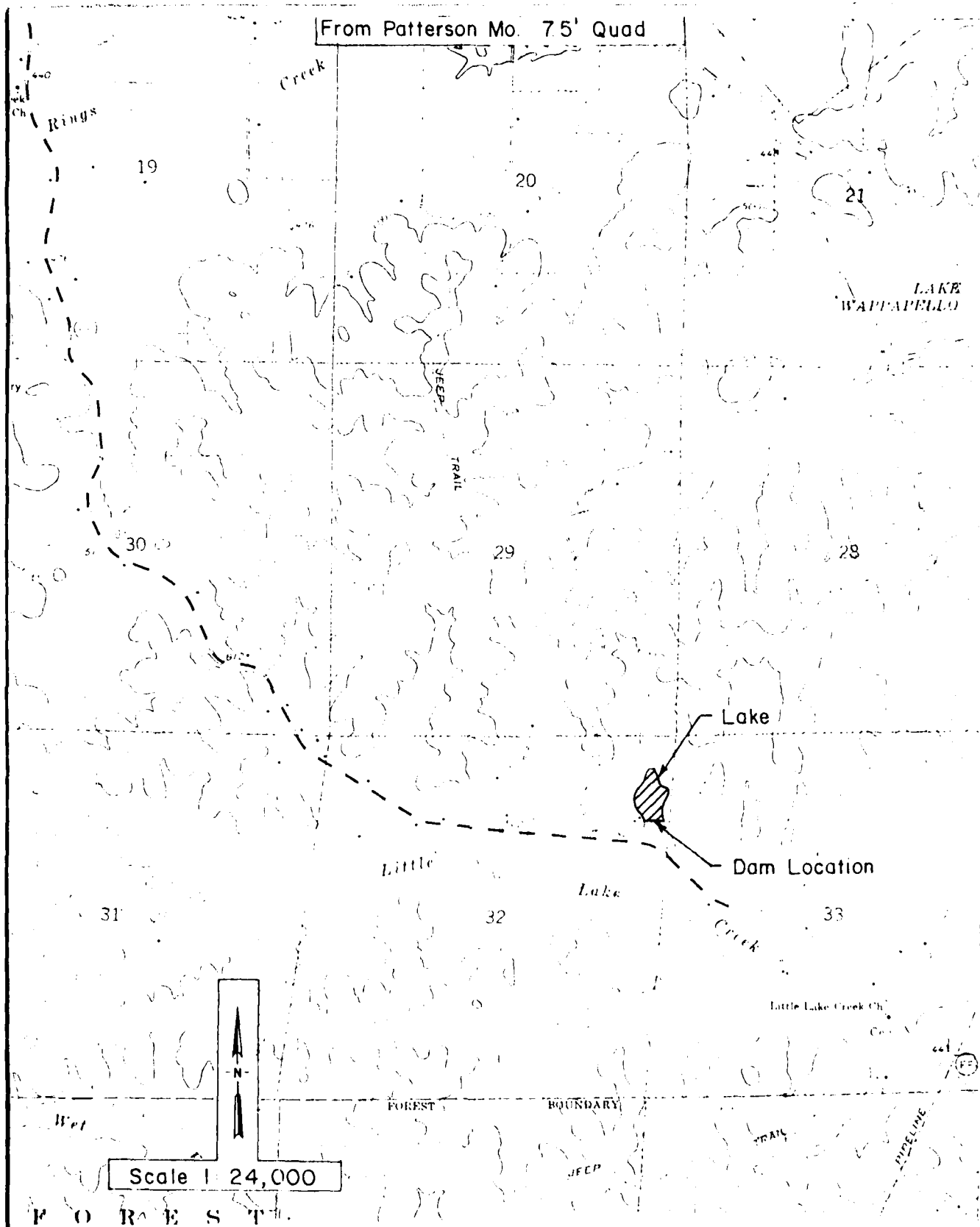
730 N. BENTON AVE. • SPRINGFIELD, MO. 65802

LOCATION MAP

A. O. SHEARRER LAKE DAM
WAYNE COUNTY, MISSOURI

MO. I. D. No. 30563

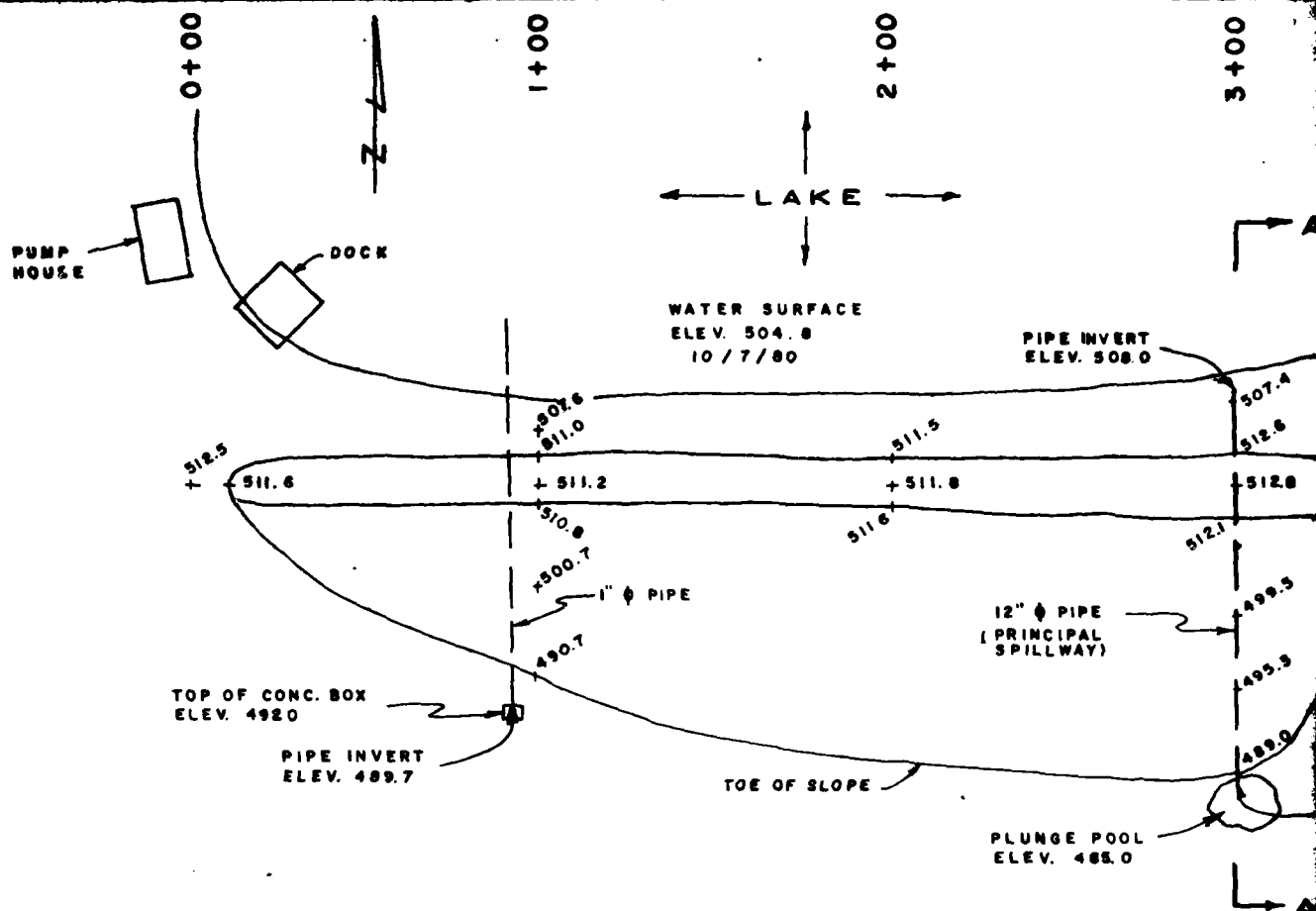
SHEET I, APPENDIX A



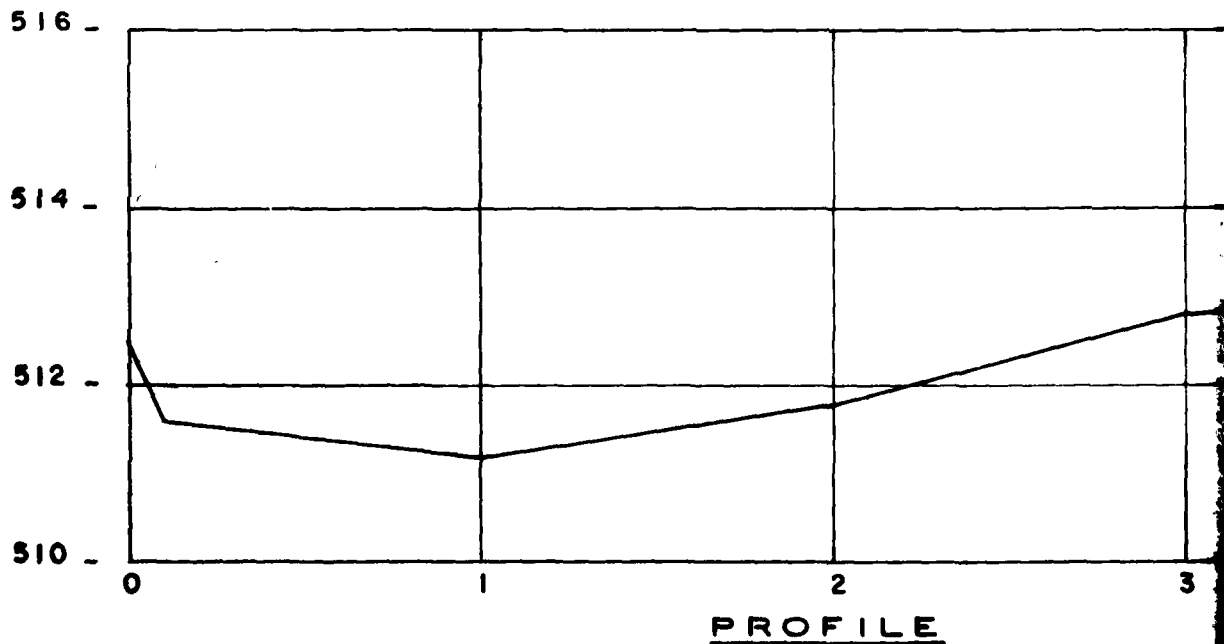
A/E ANDERSON
ENGINEERING, INC.
730 N. BENTON AVE. • SPRINGFIELD, MO. 65802

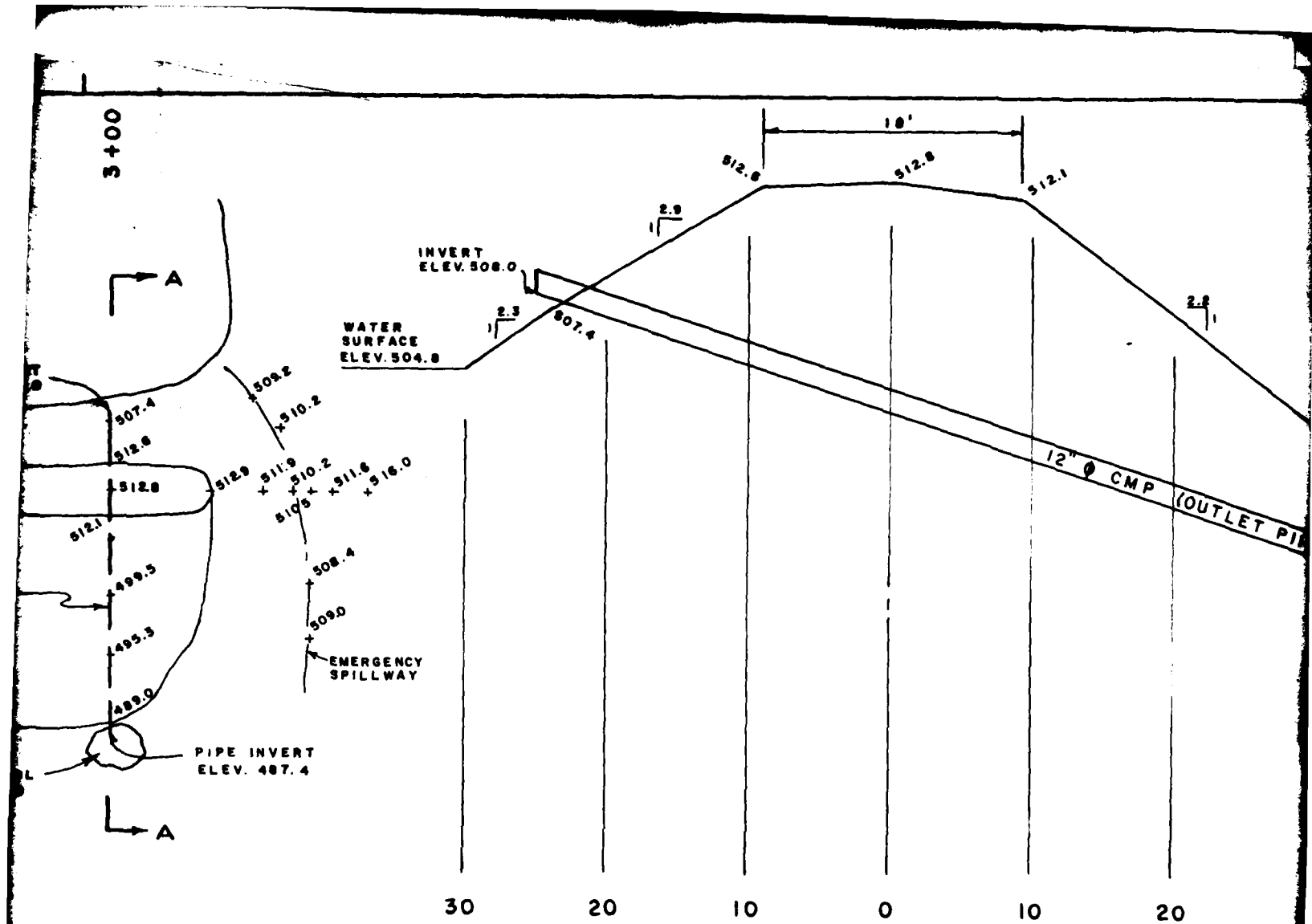
VICINITY MAP
A. O. SHEARRER DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30563

SHEET 2, APPENDIX A

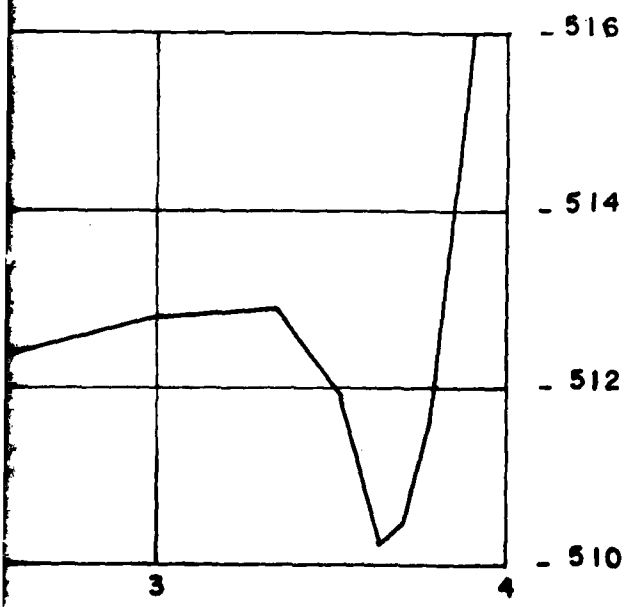


BENCHMARK:
TOP OF SE PUMP HOUSE
CONCRETE SLAB
ELEV. = 510.0 MSL





SECTION A-A STA 3

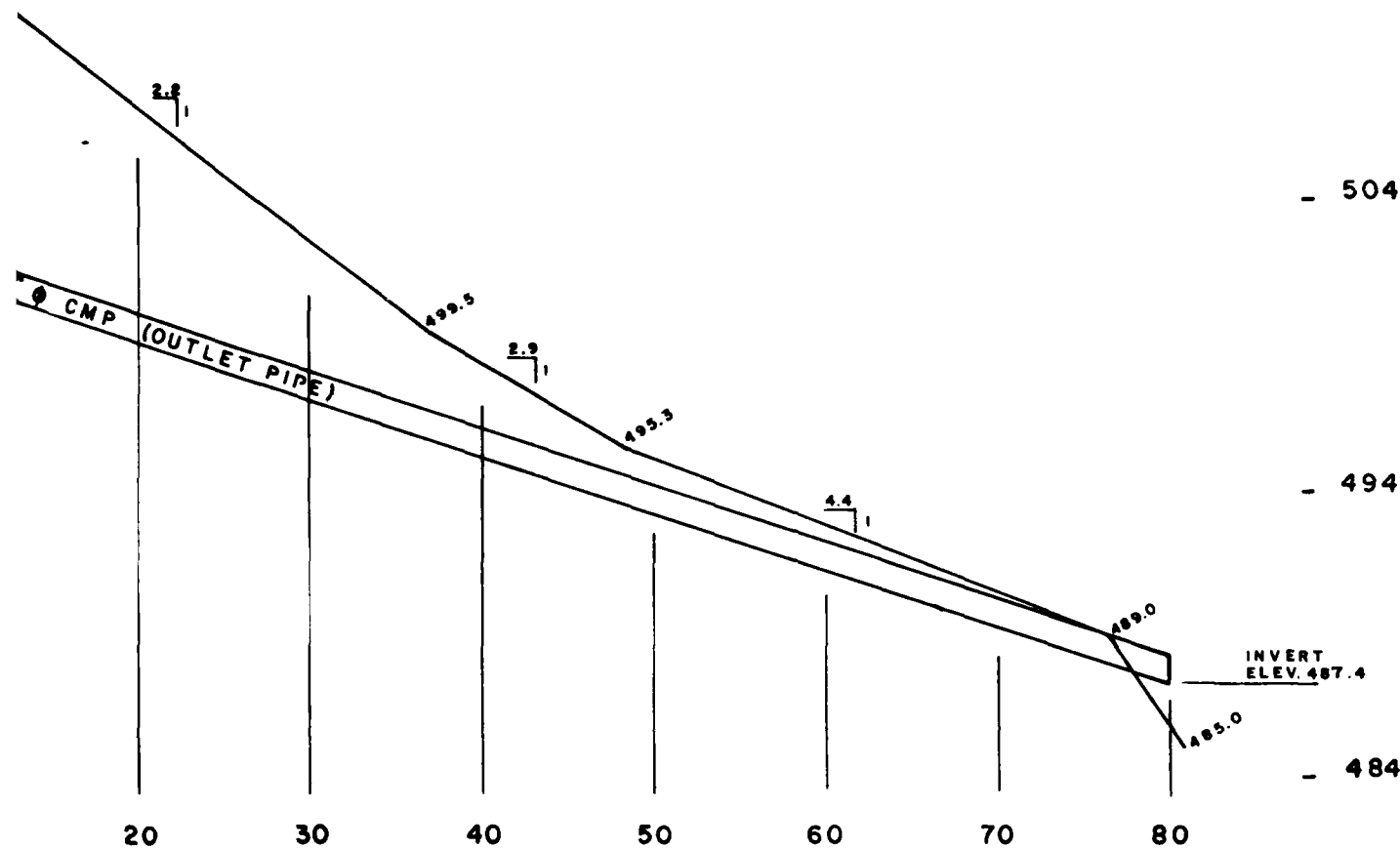


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A - A STA 3+00

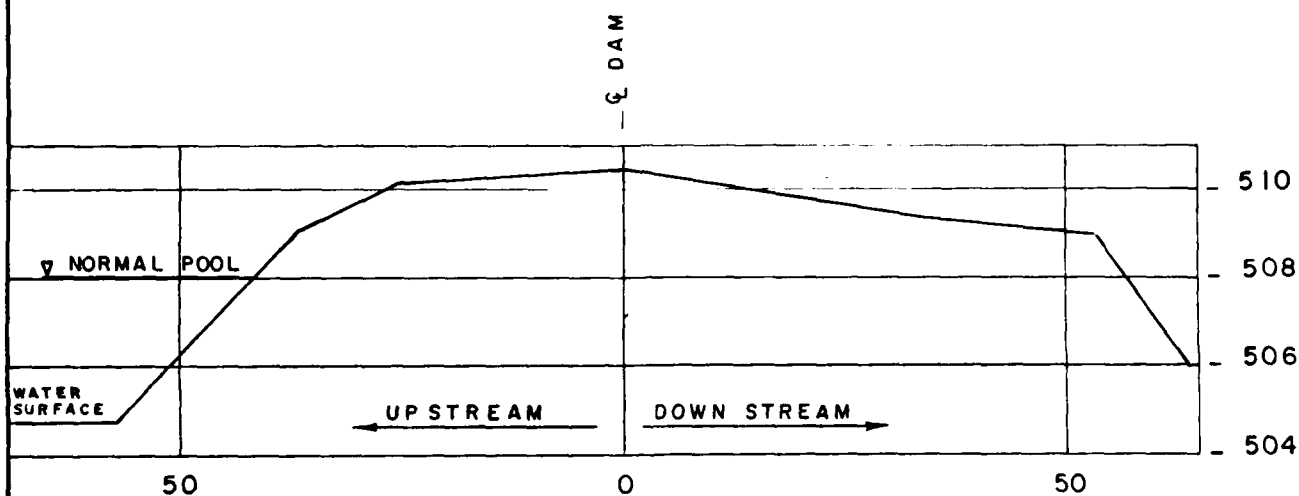
**A/E ANDERSON
ENGINEERING, INC.**
730 N. BENTON AVE. • SPRINGFIELD, MO. 65806

A. O. SHEARRER LAKE DAM

MO. No. 30563

PLAN & PROFILE
WAYNE COUNTY, MO.

SHEET 3 , APPENDIX A

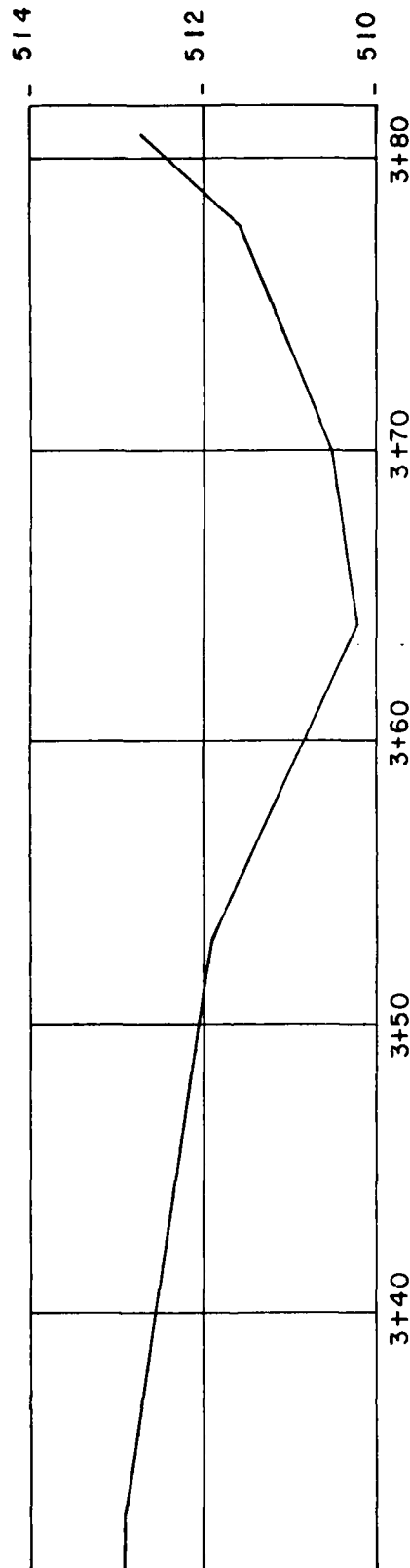


STA 3+64 @ DAM
 EMERGENCY SPILLWAY
 LONGITUDINAL PROFILE

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A. O. SHEARER LAKE DAM
 WAYNE COUNTY, MISSOURI
 MO. I.D. No. 30563
 SPILLWAY @ DAM

SHEET 4 , APPENDIX A

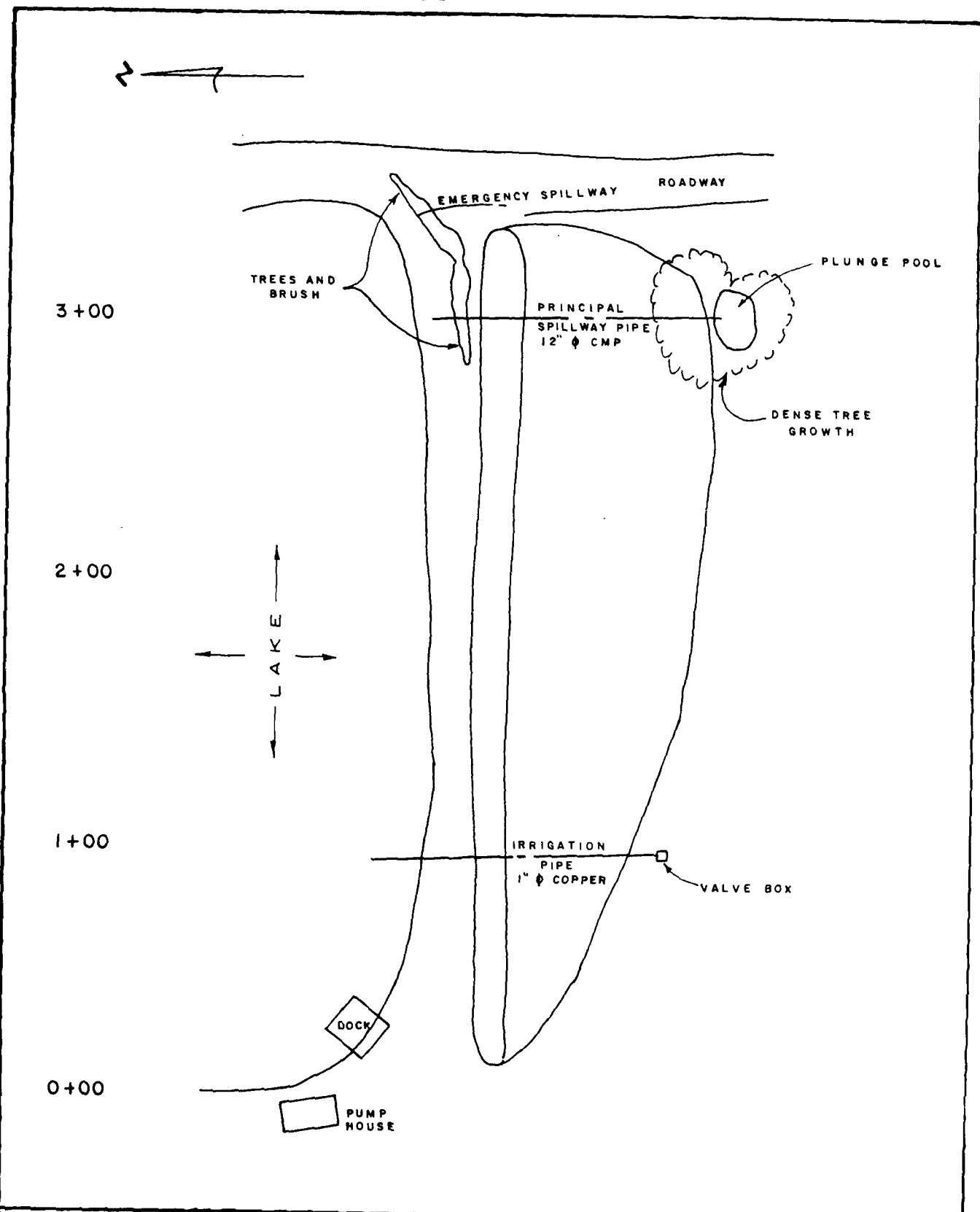


EMERGENCY SPILLWAY SECTION & DAM

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A. O. SHEARER LAKE DAM
WAYNE COUNTY, MISSOURI
MO I. D. No 30563
SPILLWAY SECTION & DAM

SHEET 5 , APPENDIX A



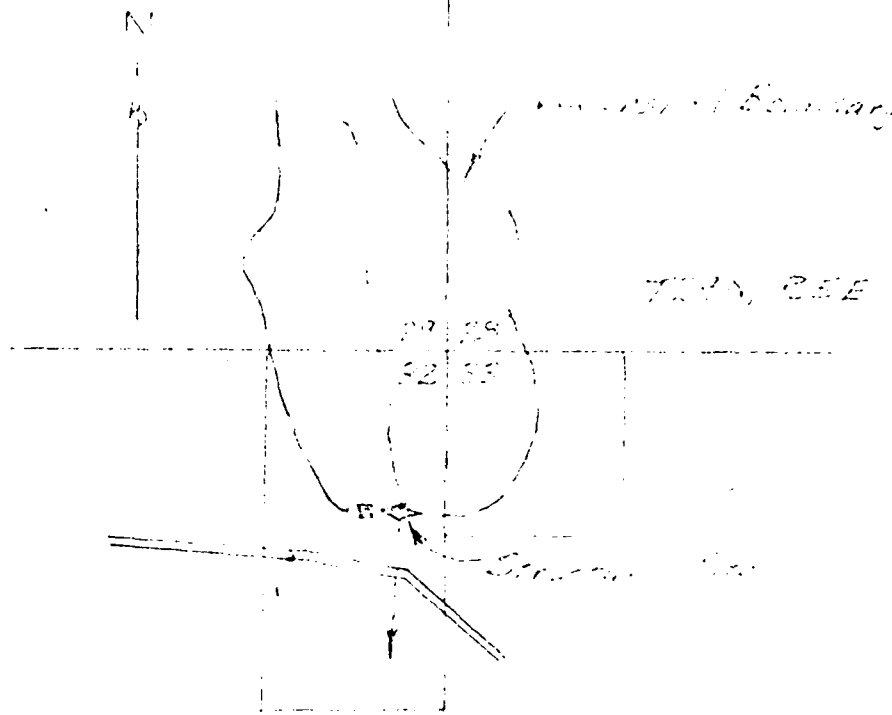
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PLAN SKETCH OF DAM

A. O. SHEARRER DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30563

SHEET 6, APPENDIX A

WATERSHED MAP



SCALE 1 INCH = 100 FEET

DESIGN DATA

DRAINAGE AREA 1.2 ACS
 $2 \times (R) \times (S) + (C) \times (S) = 1.2$
 $Q = (P) \times (R) \times (S) = 1.2$ CFS
 SURFACE AREA PERM. POOL 1.2 ACS
 24 HOUR RAINFALL 0.5 IN RUNOFF CURVE
 DESIGN RUNOFF 1.2 IN

VOL. FLOOD RUNOFF (Vr) $= \frac{1}{12} \times (DA) = 1.2$ AC FT

PIPE FLOW

$Q = \frac{2.48}{1 + K_e + K_d} \times (V) \times (S) \times (H) = 1.2$ CFS

H (TO EMER. SPILLWAY) 1.2 FT

$Q/Q = K \times (FROM 3-L-45245)$

MAXIMUM STAGE 1.2 FT

VOL. FLOOD STORAGE REQ'D. (Vs) $= K \times Vr = 1.2$ AC FT

HOOD INLET

STAGE INLET INVERT TO EMERG. SPILLWAY 1.2 FT

EMERGENCY SPILLWAY $(Q = 2.75 L H^{3/2})$

DESIGN Q 1.2 % OF Q 1.2 CFS

WIDTH (L) 1.2 FT DEPTH OF FLOW (H) 1.2 FT

FREEBOARD REQUIRED 1.2 FT

ESTIMATED QUANTITIES

QUAN. UNIT

ITEM

1.2

PIPE

1.2

PIPE

1.2

PIPE

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PIPE

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PIPE

NOTE: Rivers in longitudinal seams of C.M. Pipe under water tight coupling band shall be first head or omitted and seams be set inside and outside with a continuous S. 1 ft or less.

COOPERATOR

COOPERATING WITH

STATE

SURVEYED

DATE

HOOD INLET PIPE SPILLWAY

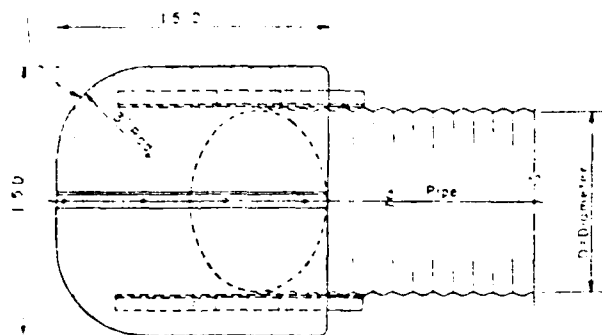
U.S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

HOOD INLET ON PIPE 6" TO 15" DIAM
DETAILS FOR FABRICATION OF INLET AND BODY

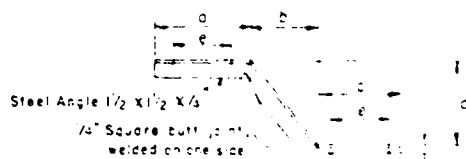
Metal Baffle shall have the same coating as the pipe to which it is attached. Where Metal Baffle is fabricated of more than one piece of metal, the separate pieces shall be securely fastened to each other. Sharp corners shall be removed. Metal Baffle may be made of corrugated or smooth sheet metal and shaped circular, square or as shown.

GAGE OF METAL RAFFLE AND DIMENSIONS OF ANGLE RAFFLE						
Diam of Gage of Angle Brace Dimensions in inches when Used						
Pipe	Boat	1	2	3	4	5
6	16					
8	16					
10	16					
12	16	8	3 1/2	4	5	5 1/2
15	16	9	4 1/2	5	6	6 1/2

Note. Angle Broce is optional

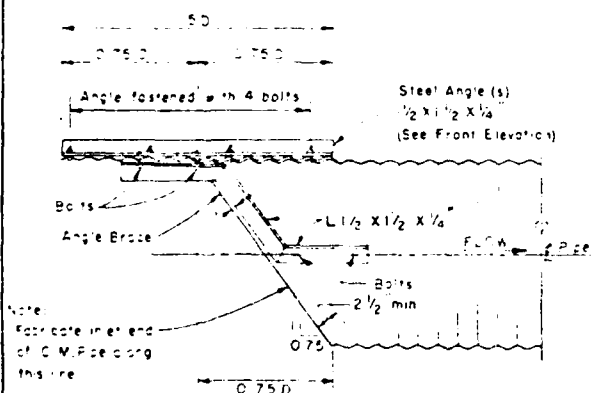


PLAN

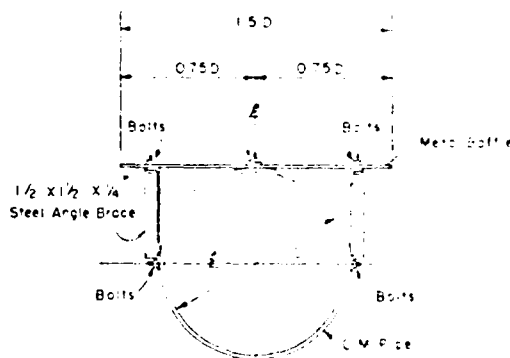


ANGLE BRACE DETAIL

(1 left and 1 right) required for each side.



SIDE ELEVATION



FRONT ELEVATION

Notes

- All bolts shall be $\frac{3}{8}$ " \times $\frac{1}{2}$ " with nut and split washers.
All holes for bolts shall be drilled $\frac{7}{16}$ " diameter.
All nuts, bolts and washers shall be galvanized, cadmium plated, or stainless steel.
All cuts shall be saw or shear cuts.
Holes in the angle brace shall be spaced and located to match corrugations in pipe and baffle.
Steel angles shall be galvanized.
All galvanizing damaged by cutting, drilling or welding shall be repaired by painting with two (2) coats of zinc dust-zinc oxide primer.

Reference

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Prepared By

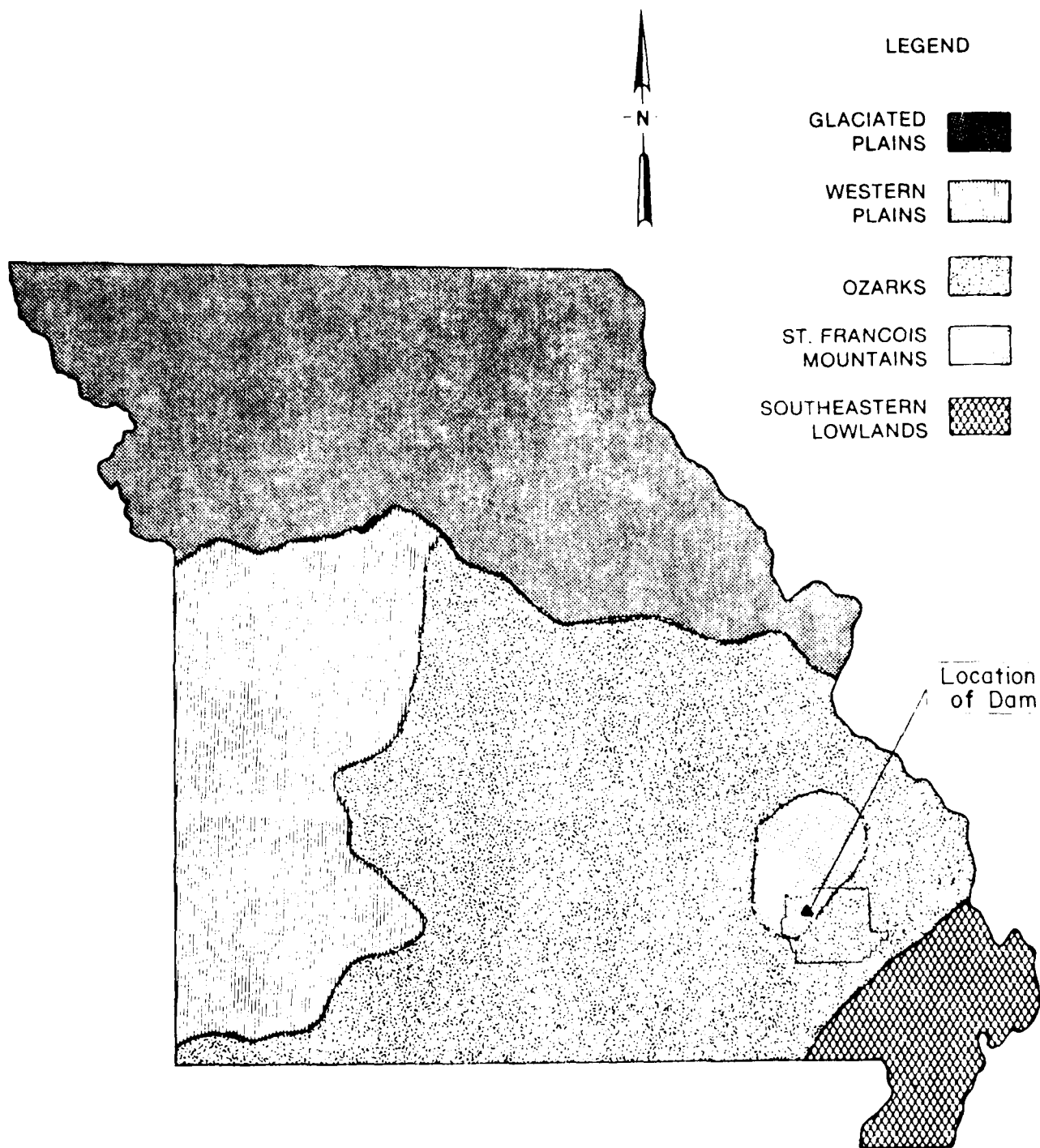
Standard Log No	
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3-L-46497

Sheet 9, Appendix A

APPENDIX B

Geology and Soils



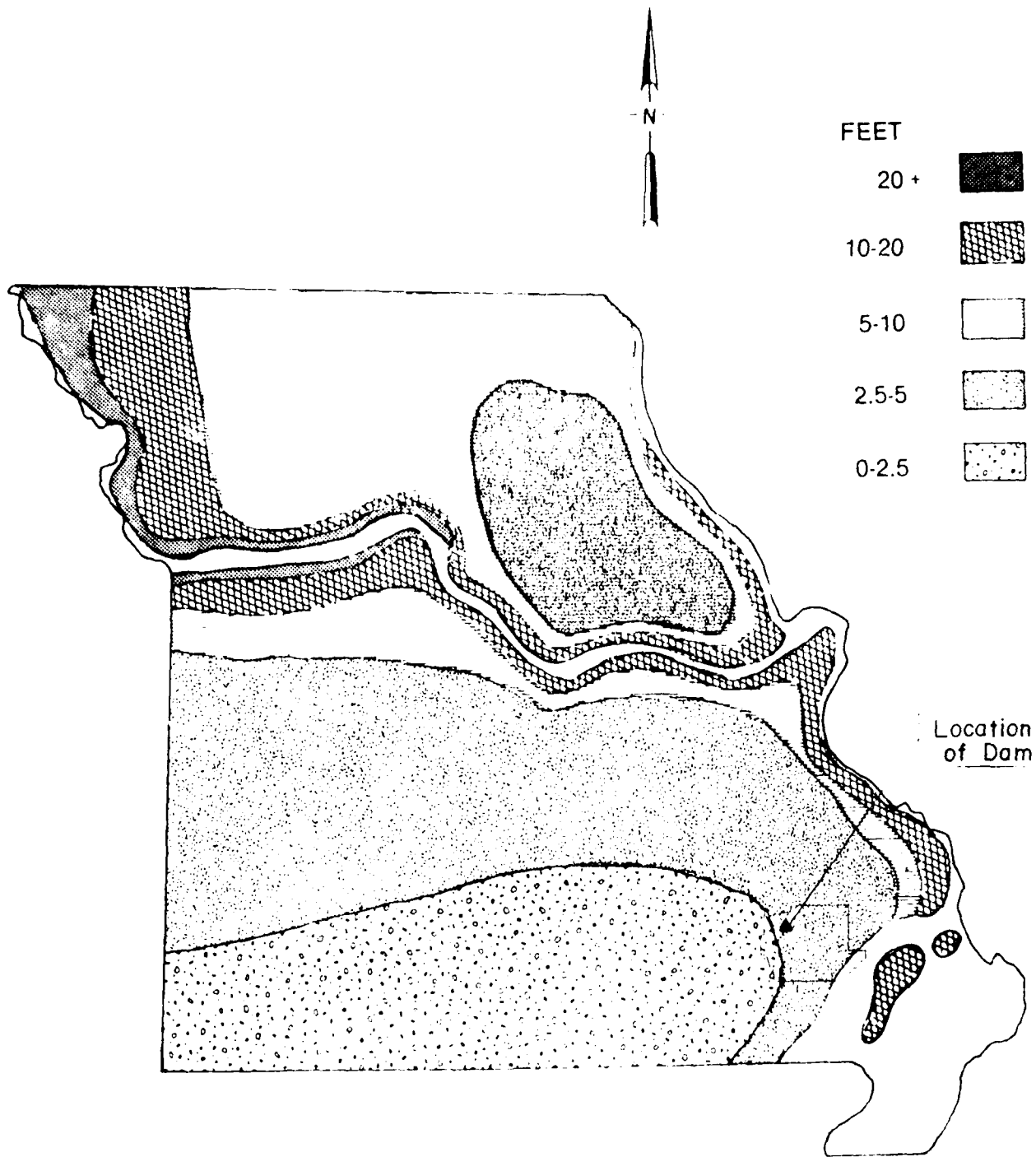
MAJOR GEOLOGIC REGIONS OF MISSOURI



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

A.O. Shearrer Dam
Wayne County, Missouri
Mo. I.D. No. 30563

SHEET 1, APPENDIX B



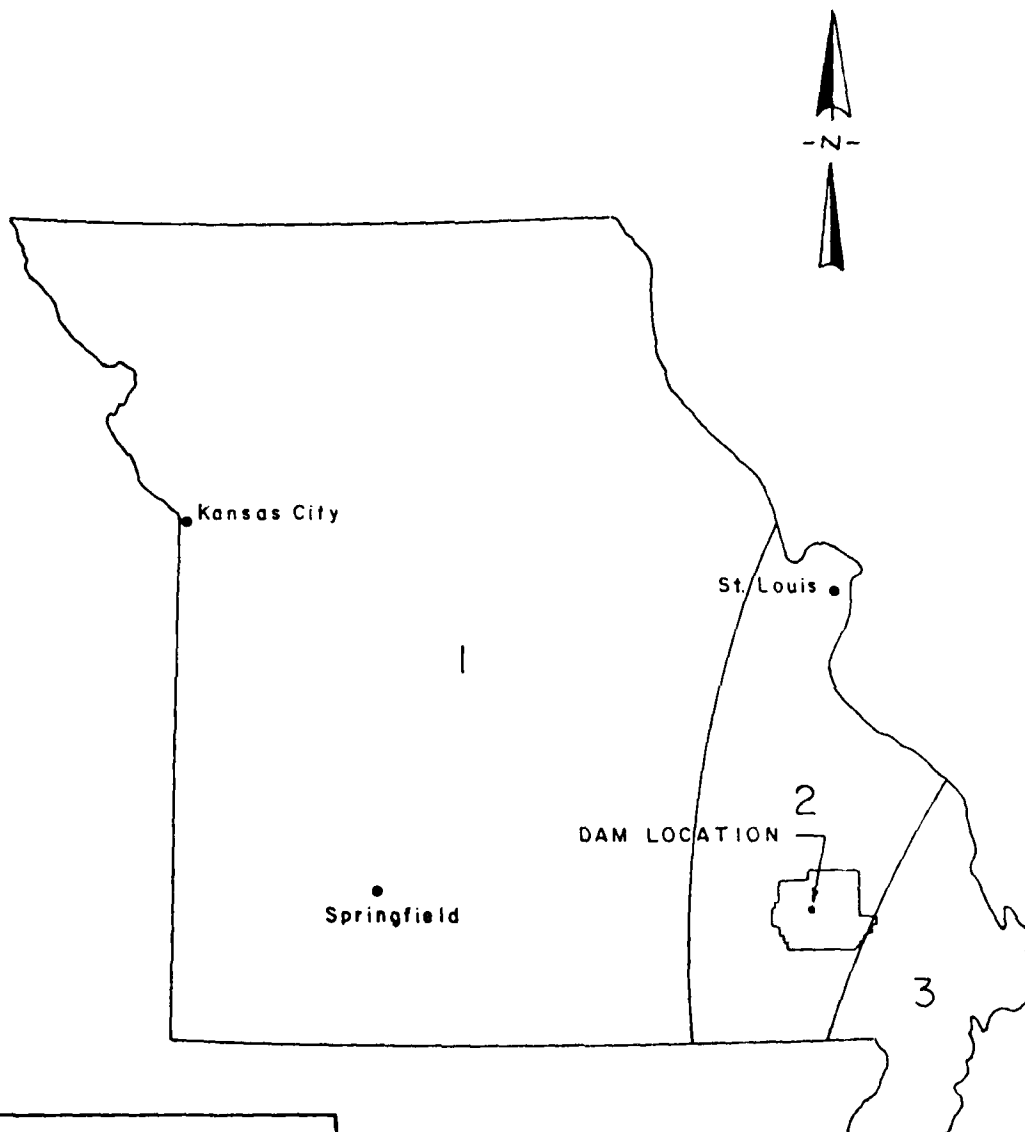
THICKNESS OF LOESSIAL DEPOSITS



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

A.O. Shearrer Dam
Wayne County, Missouri
Mo. I.D. No. 30563

SHEET 2, APPENDIX B



SEISMIC PROBABILITY	
ZONE	DAMAGE
1	MINOR
2	MODERATE
3	MAJOR

A/E ANDERSON
ENGINEERING, INC.
730 N. BENTON AVE • SPRINGFIELD, MO 65802

SEISMIC ZONE MAP

A. O. SHEARRER LAKE DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30563

SHEET 3, APPENDIX B

Greenville, Missouri

Rev. A. O. Shearrer,
1601 Veronica,
St. Louis 47, Missouri

Dear Rev. Shearrer:

M. G. Wilbur, Soil Scientist for SCS in Southeast Missouri Inc. d
at your proposed lake site recently and the findings were as
outlined below.

It is Wilbur's opinion that your site will prove to be feasible
for the proposed lake, however, on one side of the lake at
5 different boring locations we hit rock at about 10 feet depth
and could go no deeper.

This indicates one of two things;

1. There is a shelf of solid rock at a depth of about 3 1/2 feet.

or

2. We hit a layer of small rock at a depth that the
auger could not penetrate.

If, as Wilbur thinks, the condition is as described under 1, 2
above this will not present too much of a problem, however,
the rock is found to be as described under 2, it will be a
complicated thing.

In order to determine which of these conditions exists, a
depth, we would like for you to have the ground excavated
hole, about 3 ft x 3 ft, approximately 10 feet deep. If we
determined for sure the size of the rocks. We would like to
you or someone where we encountered this condition so the hole
would be dug at the right place. This could be done in a few
minutes with a bulldozer but it would be cheaper to have the
dig the hole unless there was a bulldozer on the place for
other reason.

You will understand why we desire to know the condition
before recommending that you proceed on the project of this lake.

Sincerely yours,

Albert J. Board
Greenville, Mo.

AD-315 (7-51)

U. S. DEPARTMENT OF AGRICULTURE

DATE

2/10/64

3

SPEED-MEMO

TO E. O. Hilber, Soil Scientist,
Jackson, Missouri

SUBJECT

Soil Investigation on A.O. Shearrer

FROM Albert S. Howard, Conservation
Technician, Greenville, Mo.

MESSAGE

Mr. A. O. Shearrer was here last week and dug a hole at his proposed lake site as you suggested. He was unable to get a dozer and so he dug a hole about 3 ft. x 3 ft. for a depth of approx. 4 1/2 ft.

At 36 inches he said he hit a rock about the size of a gallon bucket but after that he didn't have any more trouble except that he encountered smaller rock most of the way.

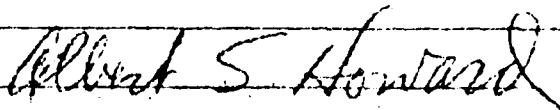
He advises that he hit a heavy clay where he stopped (I haven't seen the hole) and that water was running into it last Thursday when it was finished.

Will you want to see the hole before it is filled back up?

If not, does this information satisfy you?

Please let me hear from you on this.

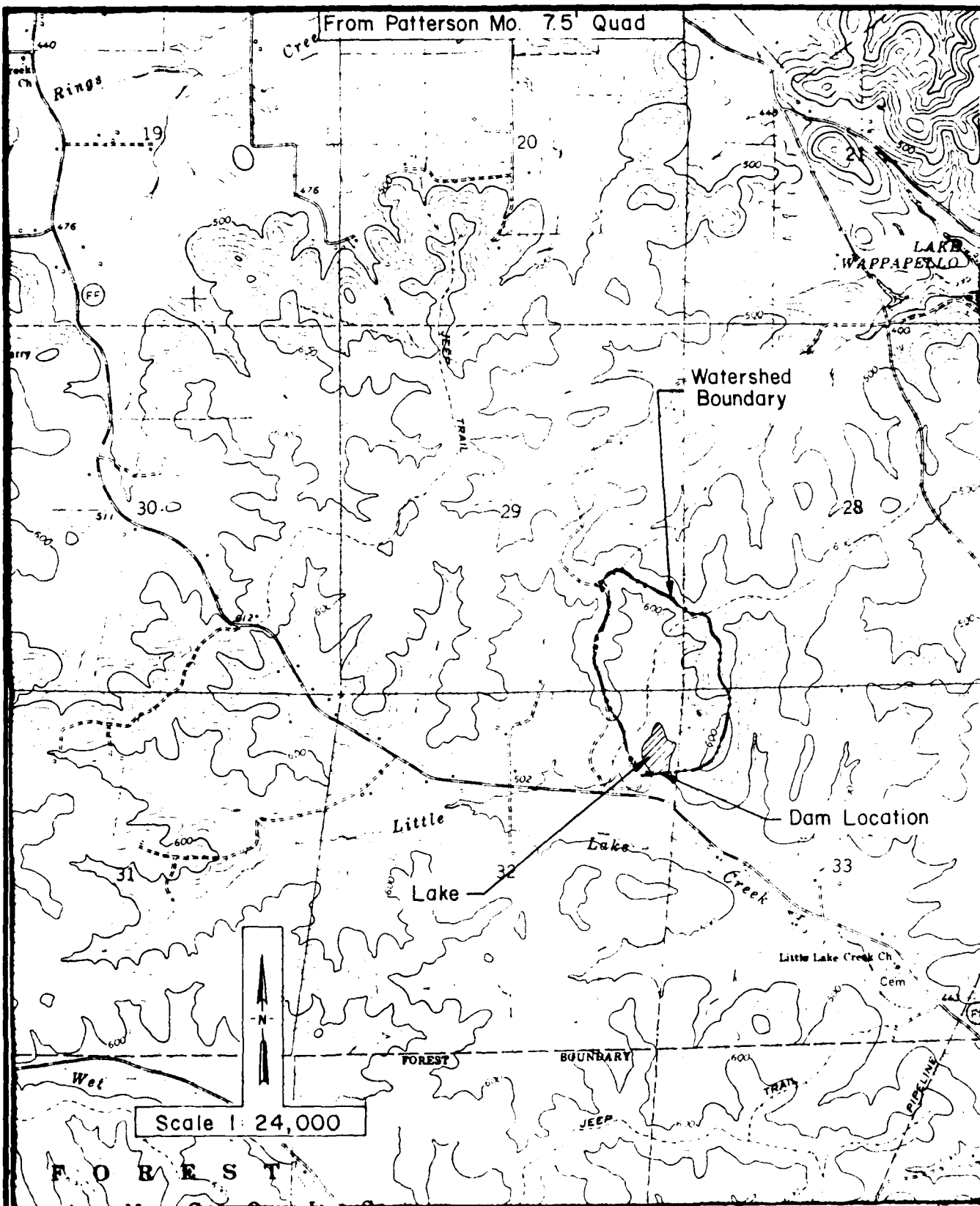
SIGNATURE



(DESTROY THIS PART 3 UPON RECEIPT OF REPLY)

APPENDIX C

Overtopping Analysis



LAKE AND WATERSHED MAP



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

A.O. Shearrer Dam
Wayne County, Missouri
Mo. I.D. No. 30563

Sheet I, Appendix C

APPENDIX C

HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination). Also, the 1 percent chance probability flood was routed through the reservoir and spillway. Doniphan, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corps of Engineers, was used in this case.

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The time of concentration was estimated using the Kirpich formula. This formula and the parameters for the unit hydrograph are shown in Table 1 (Sheet 4, Appendix C). The time of concentration was also verified from velocity estimates for the average slopes of the watershed and the main channel (Design of Small Dams, page 70, 1974 Edition).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used for the antecedent moisture conditions (AMC), and the result from the computer output, are shown in Table 2 (Sheet 5, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method assuming the starting lake elevation at normal pool. No antecedent storm was routed in order to determine the starting elevation. It was assumed that the mean annual high water elevation corresponds with the normal pool elevation. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area--storage-discharge relationships shown in Table 3 (Sheet 5, Appendix C).

The rating curve for the spillway (see Table 4 Sheet 6, Appendix C) was determined assuming pipe entrance control for the principal spillway and critical flow condition at the control section for the emergency spillway.

The flow over the crest of the dam during overtopping was determined using the non-level dam option (\$L and \$V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. The lowest elevation of the crest of the dam, obtained from survey measurements, was assumed as top of dam elevation.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 7, Appendix C). The result of the routings indicates that the spillway will pass the 1 percent probability flood without overtopping the dam.

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 8, 9, and 10 of Appendix C.

TABLE 1
SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.175	sq miles
Length of Watercourse (L)	0.473	miles
Difference in elevation (H)	152.0	ft
Time of concentration (Tc)	0.16	hrs
Lag Time (Lg)	0.10	hrs
Time to peak (Tp)	0.14	hrs
Peak Discharge (Qp)	600	cfs
Duration (D)	5	min.

<u>Time (Min.) (*)</u>	<u>Discharge (cfs) (*)</u>
0	0
5	383
10	567
15	249
20	97
25	37
30	14
35	6
40	2

(*) From the computer output

FORMULA USED:

$$T_c = \left(\frac{11.9 L^3}{H} \right)^{0.385}$$

Kirpich Formula.
From California Culverts Practice, California
Highways and Public Works, September, 1942.

$$L_g = 0.6 T_c$$

$$T_p = \frac{D}{2} + L_g$$

$$Q_p = \frac{484 A \cdot Q}{T_p}$$

Q = Excess Runoff = 1 inch

TABLE 2
RAINFALL-RUNOFF VALUES

<u>Selected Storm Event</u>	<u>Storm Duration (Hours)</u>	<u>Rainfall (Inches)</u>	<u>Runoff (Inches)</u>	<u>Loss (Inches)</u>
PMP	24	35.1	32.15	2.95
1% Prob. Flood	24	7.55	3.32	4.23

Additional Data:

- 1) Soil Conservation Service Soil Group B
- 2) Soil Conservation Service Runoff Curve CN = 78 (AMC III) for the PMF
- 3) Soil Conservation Service Runoff Curve CN = 60 (AMC II) for the
1 percent chance flood
- 4) Percentage of Drainage Basin Impervious 7 percent

TABLE 3
ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

<u>Elevation (feet-MSL)</u>	<u>Lake Surface Area (acres)</u>	<u>Lake Storage (acre-ft)</u>	<u>Spillway Discharge (cfs)</u>
485.0	0	0	-
*508.0	6.3	60.0	0
**510.2	7.5	75.0	4
***511.2	8.0	83.0	30
520.0	12.9	175.0	-

*Principal spillway crest elevation

**Emergency Spillway crest elevation

***Top of dam elevation

The above relationships were developed using data from the USGS
Patterson, Missouri 7.5 minute quadrangle map and the field
measurements.

TABLE 4

SPILLWAYS RATING CURVE

<u>Reservoir Elevation (MSL)</u>	<u>Principal Spillway (cfs)</u>	<u>Emergency Spillway (cfs)</u>	<u>Total Discharge (cfs)</u>
*508.0	0	-	0
509.0	2	-	2
**510.2	4	0	4
***511.2	5	25	30
511.5	5	45	50
512.0	6	90	96
512.5	6	145	151
513.0	7	225	232
513.6	7	385	392

*Principal spillway crest elevation

**Emergency spillway crest elevation

***Top of dam elevation

Method Used:

- 1) Principal Spillway: Using charts for corrugated-metal pipes with entrance control (and for pipes with outlet control for checking) from the U. S. Bureau of Public Roads.
- 2) Emergency Spillway: Assuming critical flow condition at the control section and approach channel losses equal to 30 percent of the velocity head at the control section.

FORMULA:

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

Design of Small Dams, Water and Power Resources
Service (Former USBR), page 553, 1974 Edition.

Q = Discharge in cubic feet per second

A = Cross sectional area in square feet

T = Water surface width in feet

g = Acceleration of gravity in ft/sec²

TABLE 5
RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (cfs)	Peak Lake Elevation (ft, MSL)	Total Storage (acre-ft)	Peak Outflow (cfs)	Depth (ft) Over Top of Dam
-	0	*508.0	60	0	-
0.10	261	511.1	82	28	-
0.11	287	**511.2	83	30	-
0.15	392	511.6	87	116	0.4
0.20	523	512.0	91	306	0.8
0.25	653	512.2	93	469	1.0
0.30	784	512.3	94	591	1.1
0.40	1,045	512.5	96	824	1.3
0.50	1,307	512.7	98	1,063	1.5
0.75	1,960	513.0	102	1,656	1.8
1.00	2,613	513.3	105	2,255	2.1

The percentage of the PMF that will reach the top of the dam is 11 percent.

*Principal spillway crest elevation

**Top of dam elevation

A OVERTOPPING ANALYSIS FOR A.O.SHEARRER DAM (# 27)
 A STATE ID NO. 30563 COUNTY NAME : WAYNE
 A HANSON ENGINEERS INC. DAM SAFETY INSPECTION JOB # 80S3001
 B 300 5
 B1 5
 J 1 9 1
 J1 .10 .15 .20 .25 .30 .40 .50 .75 1.0
 K 0 1 3 1
 K1 INFLOW HYDROGRAPH COMPUTATION **
 M 1 2 0.175 0.175 1
 P 0 27.0 102 120 130
 T -1 -78 0.07
 U2 0.16 0.10
 X 0 -.1 2
 K 1 2 0 4 1
 K1 RESERVOIR ROUTING BY MODIFIED PULS AT DAM SITE **
 Y 1 1
 Y1 1
 Y4 508.0 509.0 510.2 511.2 511.5 512.0 512.5 513.0 513.6
 Y5 0 2 4 30 50 96 151 232 392
 \$S 0 60 75 83 175
 \$E 485.0 508.0 510.2 511.2 520.0
 \$\$ 508.0
 \$D 511.2
 \$L 0 160 192 270 305 340
 \$V 511.2 511.6 511.8 512.5 512.8 513.5
 K 99

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

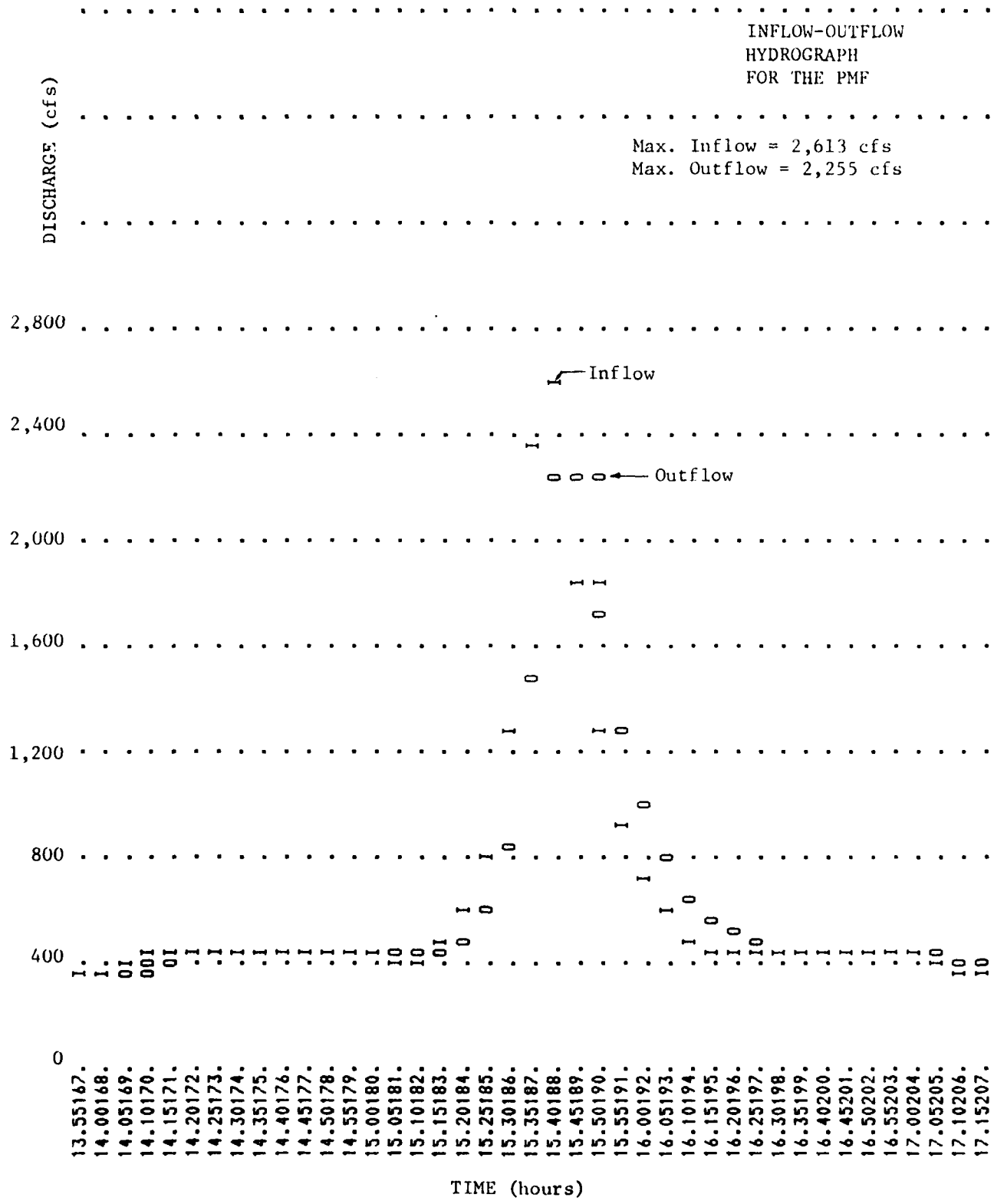
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
HYDROGRAPH AT	1	0.17	1	261.	392.	523.	653.	784.	1045.	1307.	1960.	2613.
	(	0.45)	(	7.40)	(11.10)	(14.80)	(18.50)	(22.20)	(29.60)	(37.00)	(55.50)	(74.00)
ROUTED TO	2	0.17	1	28.	116.	306.	469.	591.	824.	1063.	1656.	2255.
	(	0.45)	(	0.79)	(3.28)	(8.67)	(13.27)	(16.73)	(23.34)	(30.11)	(46.88)	(63.87)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1			INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
			ELEVATION		508.00		511.20	
			STORAGE		60.		83.	
			OUTFLOW		0.		30.	

RATIO OF PMF	MAXIMUM RESERVOIR U.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	511.12	0.00	82.	28.	0.00	18.08	0.00
0.15	511.63	0.43	87.	116.	4.00	16.00	0.00
0.20	511.95	0.75	91.	306.	4.67	15.83	0.00
0.25	512.15	0.95	93.	469.	5.75	15.75	0.00
0.30	512.27	1.07	94.	591.	6.42	15.75	0.00
0.40	512.48	1.28	96.	824.	7.58	15.75	0.00
0.50	512.66	1.46	98.	1063.	8.33	15.75	0.00
0.75	513.04	1.84	102.	1656.	10.00	15.75	0.00
1.00	513.34	2.14	105.	2255.	13.67	15.67	0.00

PMF RATIOS
OUTPUT DATA

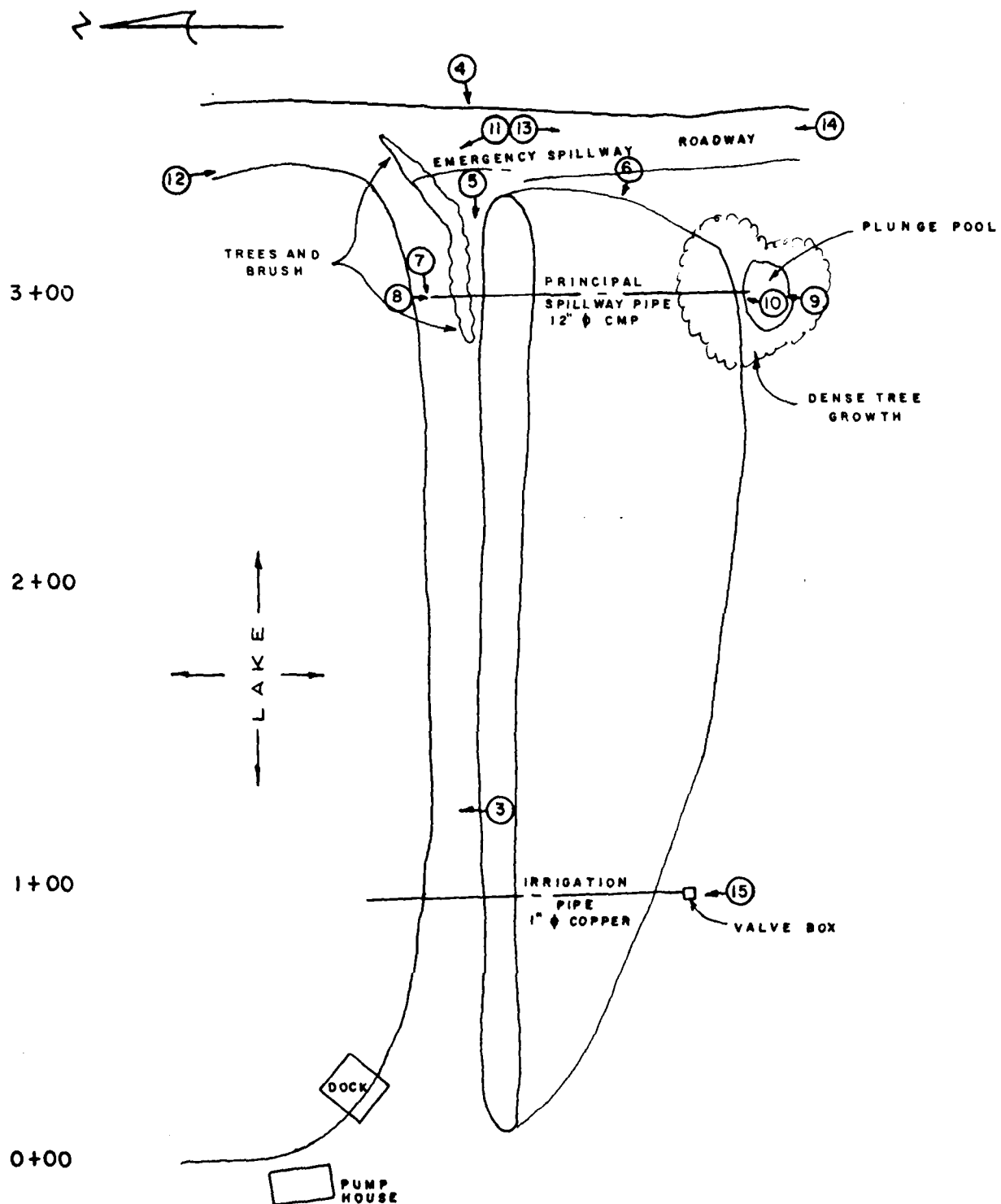


APPENDIX D

Photographs

LIST OF PHOTOGRAPHS

<u>PHOTO NO.</u>	<u>DESCRIPTION</u>
1	Aerial View of Lake and Dam (Looking East)
2	Aerial View of Dam (Looking South)
3	View of Reservoir (Looking North)
4	Crest of Embankment, Emergency Spillway in foreground, (Looking West)
5	Upstream Face of Embankment (Looking West)
6	Downstream Face of Embankment (Looking West)
7	Principal Spillway Inlet (Looking West)
8	Principal Spillway Inlet (Looking South)
9	Principal Spillway Outlet and Plunge Pool (Looking North)
10	Principal Spillway Outlet (Looking North)
11	Upstream View of Emergency Spillway Channel (Looking Northwest)
12	Emergency Spillway Inlet Channel (Looking Southeast)
13	Downstream View of Emergency Spillway Channel and Road (Looking South)
14	Emergency Spillway Outlet Channel (Looking North)
15	Valve Box for Irrigation System
16	Downstream Hazard Feature

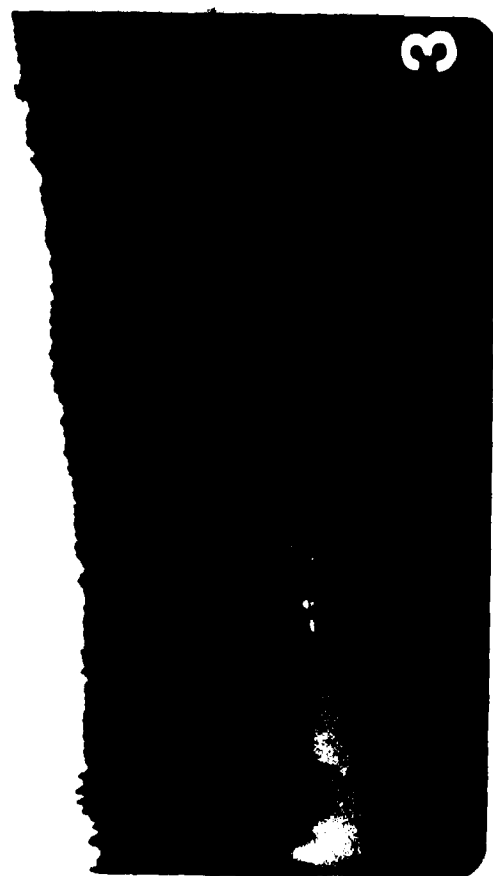
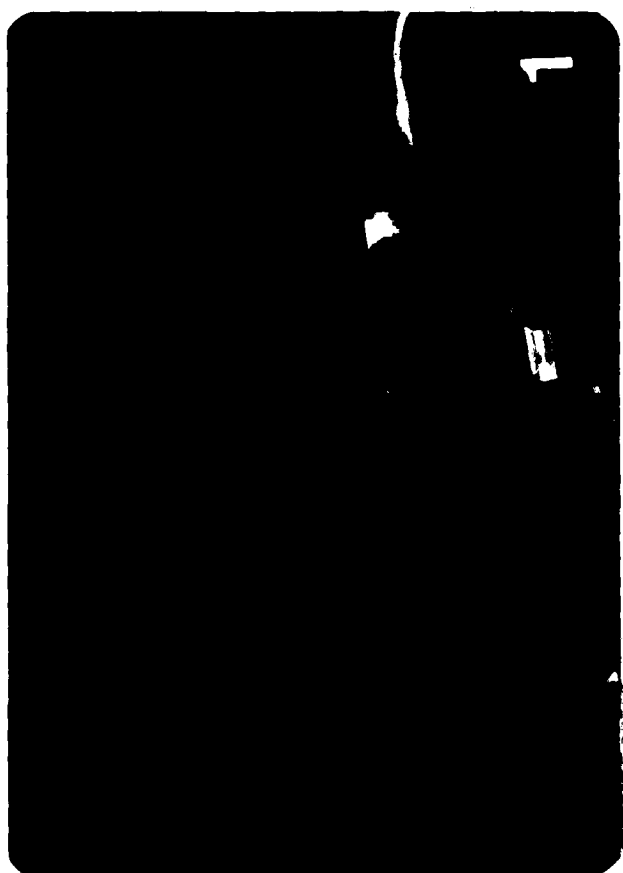


**A/E ANDERSON
ENGINEERING, INC.**
730 N. BENTON AVE. • SPRINGFIELD, MO. 65802

PHOTOGRAPHIC INDEX

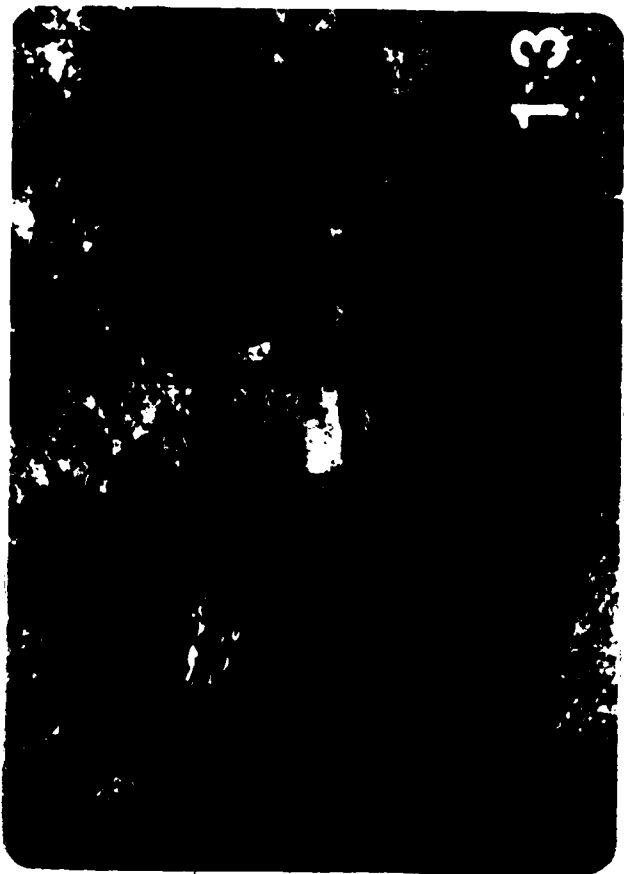
A. O. SHEARRER DAM
WAYNE COUNTY, MISSOURI
MO. I.D. No. 30563

SHEET 2, APPENDIX D









DATE
LME